

# Analysis of Different Types of Antenna for Television Network and Extracting C Band Channels

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## ABSTRACT

Television network is a system of transmitting and receiving television signals over a large area. Antenna is a device that converts electromagnetic waves into electric currents or vice versa. Antenna plays a crucial role in the performance and quality of television network. In this paper, we will analyze different types of antenna for television network, such as dipole antenna, yagi antenna, parabolic antenna and fractal antenna. We will compare their advantages and disadvantages, and suggest some criteria for choosing the best antenna for different scenarios. Dipole antenna is the simplest and most common type of antenna for television network. It consists of two metal rods or wires of equal length that are connected to a transmitter or receiver. Dipole antenna can receive signals from any direction in a horizontal plane, but has a low gain and a narrow bandwidth. Dipole antenna is suitable for local television stations or indoor applications. Yagi antenna is a directional antenna that consists of a dipole antenna and several parasitic elements, such as reflectors and directors. Yagi antenna can focus the signals in one direction and reject the signals from other directions, thus increasing the gain and reducing the interference. Yagi antenna has a moderate bandwidth and can be easily adjusted to different frequencies. Yagi antenna is suitable for long-distance television network or outdoor applications. Parabolic antenna is another directional antenna that consists of a parabolic reflector and a feed horn. Parabolic antenna can concentrate the signals into a narrow beam and achieve a high gain and a wide bandwidth. Parabolic antenna can also receive signals from satellites or other high-altitude sources. Parabolic antenna is suitable for satellite television network or high-definition television network. Fractal antenna is a novel type of antenna that uses fractal geometry to design its shape and structure. Fractal antenna can have multiple resonant frequencies and a large effective area, thus increasing the bandwidth and the efficiency. Fractal antenna can also have self-similarity and scalability, which means it can be miniaturized or enlarged without affecting its performance. Fractal antenna is suitable for digital television network or wireless communication network. In conclusion, different types of antenna have different characteristics and applications for television network. Depending on the factors such as distance, frequency, direction, interference, quality and cost, one can choose the best antenna for their specific needs.

**Keywords:** Yagi antenna; Television network; Bandwidth; Efficiency.

## 1. Introduction

Television networks use different types of antenna to transmit and receive signals over long distances [1]. Antenna are devices that convert electromagnetic waves into electric currents or vice versa. The performance of an antenna depends on several factors, such as its shape, size, orientation, frequency, polarization and environment [2].

In this paper, we will compare and contrast three common types of antenna for television network introduction: dipole, yagi and parabolic [3]. We will discuss their advantages and disadvantages, as well as their applications and limitations in different scenarios.

## 2. Related Works

The paper by J.-S Lee et al. examines the feasibility of sharing the C-band spectrum between satellite and terrestrial systems for future mobile communication services [4]. The authors propose a novel interference mitigation scheme based on adaptive beamforming and power control to reduce the interference between the coexisting systems [5]. The paper also presents a simulation study to evaluate the performance of the proposed scheme in various scenarios [6]. The paper concludes that the C-band spectrum sharing can be achieved with minimal degradation of the quality of service for both satellite and terrestrial users [7]. The paper by M.-K Chung et al. [8] presents a comprehensive analysis of the coexistence and interference scenarios between satellite and terrestrial systems in the C-band

spectrum, which is a candidate frequency band for future mobile communication services. The authors propose a novel spectrum sharing scheme based on adaptive power control and beamforming techniques, and evaluate its performance using realistic simulation models [9]. The results show that the proposed scheme can significantly reduce the interference and improve the spectral efficiency of both systems, while ensuring the protection of existing satellite services [10].

The paper by S.-H. Park et al. [11] titled Spectrum Sharing Transmission Scheme for Satellite-Terrestrial Integrated Networks in C-Band, was published in IEEE Transactions on Vehicular Technology. The paper proposes a novel transmission scheme that enables spectrum sharing between satellite and terrestrial networks in C-band, which is a frequency band that can support high-speed data transmission and wide coverage [12]. The paper also analyzes the performance of the proposed scheme in terms of achievable rate and outage probability, and compares it with existing schemes. The paper demonstrates that the proposed scheme can improve the spectral efficiency and reliability of satellite-terrestrial integrated networks in C-band [13].

### 3. Challenges and Limitations of Existing Systems

(i) Antennas are devices that convert electromagnetic waves into electric currents or vice versa. They are essential for transmitting and receiving television signals over long distances [14].

(ii) There are different types of antennas that can be used for television network existing systems, depending on the frequency band, the coverage area, the polarization, and the gain of the antenna [15].

Some common types of antennas for television network existing systems are:

**(a) Dipole antenna:** A simple and widely used type of antenna that consists of two metal rods or wires of equal length, connected to a transmission line. The dipole antenna has a bidirectional radiation pattern and can operate in various frequency bands. It is often used as a reference antenna for measuring the gain of other antennas.

**(b) Yagi-Uda antenna:** A directional antenna that consists of a dipole antenna and several parasitic elements (directors and reflectors) arranged in a line. The parasitic elements enhance the radiation in one direction and suppress it in the opposite direction, resulting in a high gain and a narrow beamwidth. The Yagi-Uda antenna is commonly used for terrestrial television broadcasting and reception.

**(c) Horn antenna:** A flared metal waveguide that acts as a high-pass filter and radiates electromagnetic waves from its aperture. The horn antenna has a wide bandwidth, a high directivity, and a low standing wave ratio (SWR). It is often used as a feed antenna for parabolic reflectors or as a standard antenna for calibration purposes.

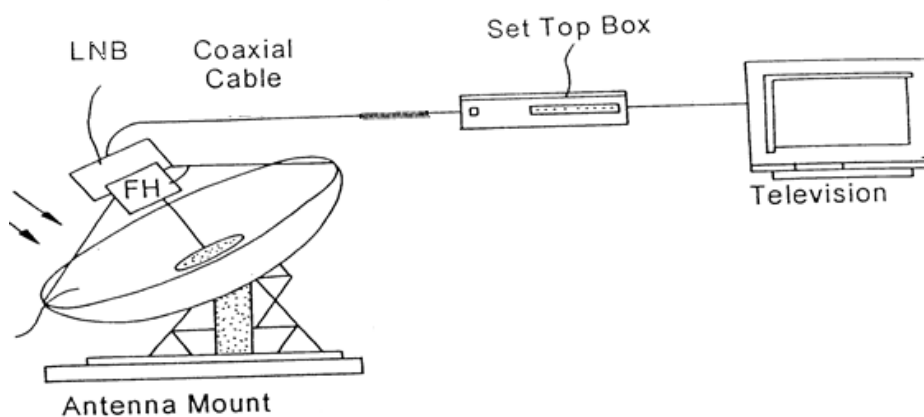
**(d) Parabolic reflector antenna:** A high-gain antenna that consists of a parabolic-shaped reflector and a feed antenna at its focal point. The parabolic reflector collects and focuses the electromagnetic waves from the feed antenna into a narrow beam or vice versa. The parabolic reflector antenna can operate in various frequency bands and polarizations. It is widely used for satellite television broadcasting and reception, as well as for radio astronomy and radar applications.

**(e) Helical antenna:** A spiral-shaped wire that forms a helix around a cylindrical support. The helical antenna has a circular polarization and can operate in either axial mode or normal mode, depending on the dimensions of the helix. The axial mode helical antenna has a high gain and a narrow beamwidth along the axis of the helix, while the

normal mode helical antenna has an omnidirectional radiation pattern perpendicular to the axis of the helix. The helical antenna is often used for satellite communication and global positioning system (GPS) applications.

#### 4. Proposed System

Television networks use different types of antenna to transmit and receive signals in the electromagnetic spectrum. One of the most common types of antenna is the c band parabolic antenna, which operates in the frequency range of 4 to 8 GHz. A c band parabolic antenna consists of a circular or elliptical dish that reflects the incoming signal to a focal point, where a feed horn collects and converts it to an electrical signal. The feed horn also emits the outgoing signal to the dish, which directs it to a specific direction. The advantages of c band parabolic antennas are that they have high gain, low noise, and good resistance to interference and weather conditions. However, they also have some disadvantages, such as large size, high cost, and narrow beamwidth. Therefore, c band parabolic antennas are suitable for long-distance communication and broadcasting, but not for mobile or local applications.



##### (a) Antenna

A C-band parabolic antenna is a type of antenna that uses a parabolic reflector, a curved surface with the shape of a parabola, to direct radio waves in a narrow beam. The C-band is a frequency range from 4 to 8 GHz that is used for satellite communications, radar, and microwave links. A C-band parabolic antenna has a dish-like shape and is usually mounted on a pole or a tower. The antenna has a small feed antenna at the focal point of the reflector, which receives or transmits the radio signals. The size of the antenna depends on the desired gain and beamwidth, as well as the wavelength of the radio waves. For a typical C-band parabolic antenna operating at 4 GHz, the diameter of the dish is about 2.4 meters (8 feet) and the beamwidth is about 2.6 degrees. C-band parabolic antennas are widely used for receiving signals from satellites with high or medium power, such as television broadcasts, weather data, and internet access.

##### (b) LNB

C band LNB is a type of low noise block downconverter that is used to receive satellite signals in the C band frequency range, which is 3.4 to 4.2 GHz. A C band LNB converts the high frequency signals from the satellite dish to a lower frequency range in the L band, which is 950 to 1450 MHz. This allows the signals to be transmitted over a coaxial cable to a satellite receiver or a set-top box. There are different types of C band LNBs available in the market, such as single polarity, dual polarity, external reference, phase locked loop (PLL), and 5G filter. Single

polarity LNBs can receive either vertical or horizontal signals, but not both at the same time. Dual polarity LNBs can switch between vertical and horizontal signals by changing the voltage supplied by the receiver. External reference LNBs require a separate 10 MHz reference signal to stabilize their local oscillator frequency. PLL LNBs use an internal crystal oscillator to lock their local oscillator frequency, and are more stable and accurate than external reference LNBs. 5G filter LNBs have a built-in filter that blocks the interference from nearby 5G mobile towers, which can cause signal fluctuations in C band signals.

C band LNBs are widely used for satellite TV broadcasting, internet access, telecommunication, and radio astronomy applications. They are especially suitable for regions with heavy rainfall, as C band signals are less affected by rain fade than higher frequency bands. However, C band LNBs also require a larger dish size than higher frequency bands, and may face more interference from terrestrial sources.

We are using a 5G filter LNB is a device that allows satellite receivers to receive signals in the C-band frequency range without being affected by the interference from 5G cellular networks. The 5G filter LNB has a built-in bandpass filter that blocks or attenuates signals in the 3.4-3.8 GHz range, which is used by some 5G networks, while passing through signals in the 3.7-4.2 GHz range, which is used by C-band satellites. The 5G filter LNB can improve the signal quality and reliability of satellite communication systems by reducing the noise and distortion caused by 5G interference.

#### **(c) Coaxial Cable**

A C band coaxial cable is a type of transmission line that can carry radio frequency signals in the C band range, which is from 4 to 8 GHz. Coaxial cables consist of a central conductor surrounded by a dielectric material and a shield, which reduces interference and losses. C band coaxial cables are commonly used for satellite communications, radar systems, and microwave links. They have a characteristic impedance of 50 ohms and a typical attenuation of 0.2 dB per meter at 4 GHz.

#### **(d) Set Top Box**

A C band set top box is a device that allows you to receive satellite television signals in the C band frequency range, which is between 3.7 and 6.4 GHz. A C band set top box typically consists of a dish antenna, a low-noise block downconverter (LNB), a receiver, and a decoder. The dish antenna collects the signals from the satellite and reflects them to the LNB, which amplifies and converts them to a lower frequency. The receiver then tunes to the desired channel and sends the signal to the decoder, which decrypts and decompresses the signal for display on your TV screen. A C band set top box can offer you access to a wide range of channels, including international, regional, and niche content. However, you may need a larger dish antenna and a clear line of sight to the satellite to receive C band signals.

#### **(e) Television**

Television is a device that allows us to watch moving images and sound on a screen. It can also refer to the medium of television transmission, which uses electromagnetic waves or digital signals to send programs to different receivers. Television is a popular source of entertainment, information, education, and advertising for millions of

people around the world. Television has evolved from the early days of black-and-white broadcasting to the modern era of high-definition, smart, and internet-connected TVs that offer a variety of content and services.

## 5. Methodology

- Identify the C-band frequency range that you want to use for your application. C-band is typically defined as 4 to 8 GHz, but some regions may have different allocations or restrictions.
- Choose the appropriate antenna type and size for your C-band signal. The antenna should have a high gain and a low noise figure to maximize the signal quality and minimize interference. The antenna size depends on the wavelength of the C-band signal and the desired beamwidth. For example, a 3-meter dish antenna can provide a beamwidth of about 2 degrees at 6 GHz.

**STEP 1:** Install the antenna on a stable and secure mount that can withstand wind and weather conditions. The antenna should be pointed towards the satellite or the terrestrial station that you want to communicate with. You may need to adjust the azimuth and elevation angles of the antenna to align it with the signal source. You can use a compass, a protractor, or a satellite finder tool to help you with the alignment.

**STEP 2:** Connect the antenna to a low-noise block downconverter (LNB) that can receive and amplify the C-band signal. The LNB should have a local oscillator frequency that matches the intermediate frequency (IF) of your receiver or modem. For example, if your receiver operates at 950 to 1450 MHz, you may need an LNB with a local oscillator frequency of 5150 MHz to downconvert the C-band signal to the IF range.

**STEP 3:** Connect the LNB to a coaxial cable that can carry the IF signal to your receiver or modem. The coaxial cable should have a low attenuation and a high shielding to prevent signal loss and interference. You may also need to use connectors, adapters, or splitters to connect multiple devices or cables together.

**STEP 4:** Connect the coaxial cable to your receiver or modem that can decode and process the C-band signal. The receiver or modem should have a compatible modulation and coding scheme, as well as a matching symbol rate and bandwidth, to demodulate and decode the C-band signal. You may also need to configure some parameters such as frequency, polarization, and encryption keys to access the C-band signal.

**STEP 5:** Test and troubleshoot your C-band system to ensure that it is working properly. You can use a spectrum analyzer, a power meter, or a bit error rate tester to measure and monitor the quality and performance of your C-band signal. You can also check for any errors or warnings on your receiver or modem display or logs. If you encounter any problems, you may need to check your connections, settings, or components and make adjustments as needed.

**STEP 6:** Turn on the c-band receiver and the TV set and select the appropriate input source on the TV. You should see a menu or a signal meter on the screen that indicates the quality and strength of the signal from the satellite. You can adjust the dish position, skew, and elevation to optimize the signal quality.

**STEP 7:** Scan for channels on the c-band receiver using the remote control or the buttons on the receiver. You should see a list of available channels that you can watch on your TV. You can also edit, delete, or add channels manually using the receiver's menu.

Finally, we extract television signal from C Band Antenna.

## 6. Advantages and Applications

### 6.1. Merits of proposed System

- higher bandwidth and data rates than lower frequency bands.
- less interference and attenuation than higher frequency bands.
- better coverage and penetration than higher frequency bands.
- more availability and affordability than higher frequency bands.
- c-band is suitable for applications that require high reliability, performance, and quality.

### 6.2. Application of proposed System

**Satellite communication:** C-band is used for fixed and mobile satellite services, especially for communication between ground stations and satellites. C-band satellites typically have 24 transponders, each with a bandwidth of 36 MHz, and require a 1.8 to 3.7 meter dish for reception.

**Radar systems:** C-band is also used for air traffic control, weather, and marine radar systems, as it has a good balance of range and resolution. C-band radars can cover distances of up to 300 km and can detect aircraft, ships, rain, and clouds.

**Wireless networks:** C-band is one of the frequency bands that has been allocated for 5G networks, as it offers a compromise between coverage and capacity. C-band can support data rates of up to 1 Gbps and can cover urban and suburban areas with a cell radius of up to 10 km.

## 7. Results

The c band antenna is a type of satellite dish that can receive signals from satellites in the c band frequency range, which is between 3.7 and 6.4 GHz. The c band antenna has a diameter of about 2 to 3 meters and is usually mounted on a pole or a roof. The c band antenna can provide access to a variety of television channels, including international, regional, and local ones. The c band antenna has some advantages over other types of satellite dishes, such as better signal quality, less interference, and more coverage. However, the c band antenna also has some disadvantages, such as higher cost, larger size, and more maintenance. Therefore, the c band antenna is suitable for television project that requires high-quality and diverse content, but also has enough budget and space to install and maintain it.

## 8. Conclusion

C band is a frequency range that is widely used for satellite communications, radar systems, and wireless networks. C band offers advantages such as high bandwidth, low interference, and global coverage. However, C band also faces challenges such as spectrum congestion, signal attenuation, and regulatory issues. In this paper, we have reviewed the current applications and trends of C band in various domains, and discussed the opportunities and challenges for future development.

Some of the future directions for C band research and innovation include:

- Developing new technologies and techniques to improve the efficiency and performance of C band systems, such as adaptive modulation and coding, beamforming, interference mitigation, and network optimization.
- Exploring new applications and services that can benefit from C band capabilities, such as broadband access, 5G communications, Internet of Things, cloud computing, and remote sensing.

## Declarations

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### Competing Interests Statement

Authors have declared no competing interests.

### Consent for Publication

The authors declare that they consented to the publication of this study.

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